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(54) **SPRING LOADED LID**

(56)

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CPC ..... **H05K 7/10** (2013.01); **H05K 7/1053** (2013.01); **H05K 7/18** (2013.01); **H05K 13/00** (2013.01); **Y10T 29/49117** (2015.01)

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See application file for complete search history.

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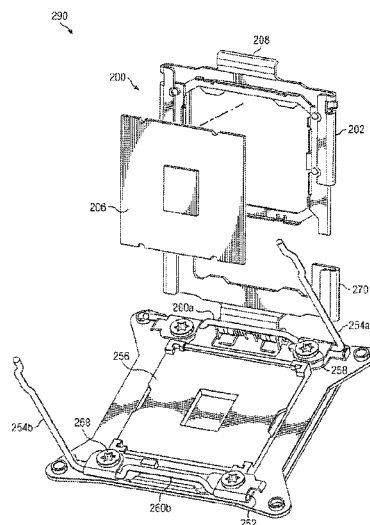
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**ABSTRACT**

A method and apparatus for loading IC's into a socket lid is disclosed. The IC is first loaded into a lid. Once the IC has been loaded into the lid, the lid is rotated into a closed position on the frame. The lid is then locked in place on the frame by rotating at least one locking lever into a closed latched position, where the locking lever forces the lid down against the socket contacts against a spring.

**15 Claims, 13 Drawing Sheets**



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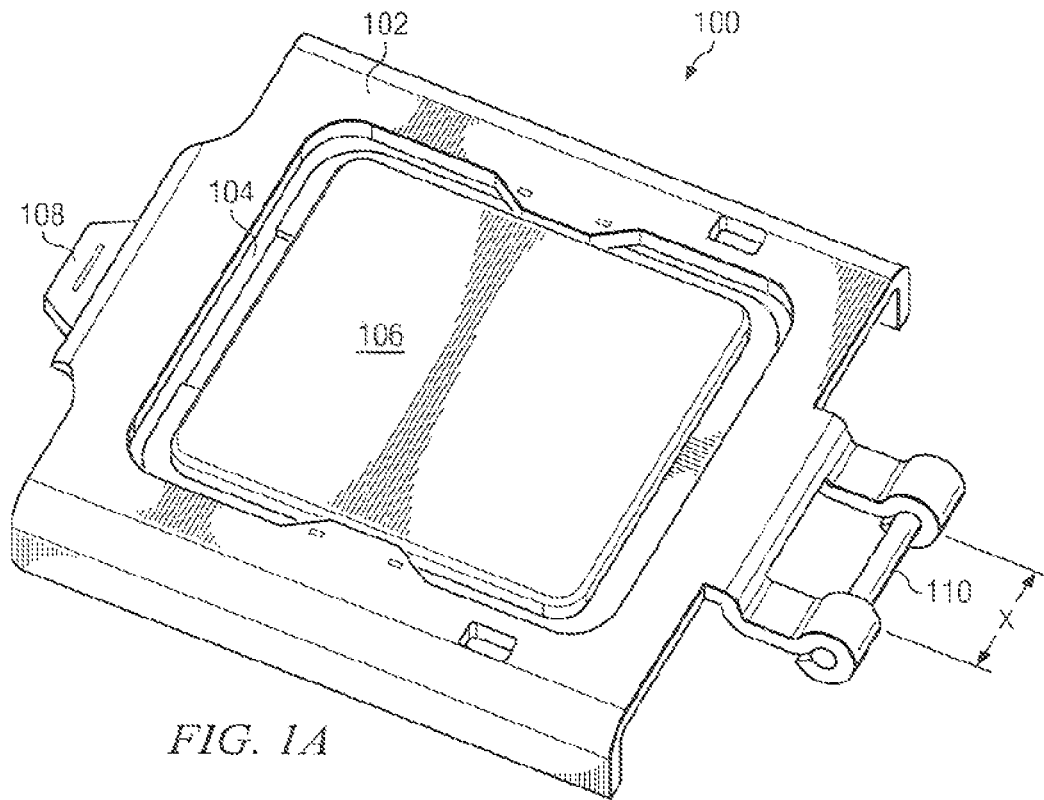


FIG. 1A

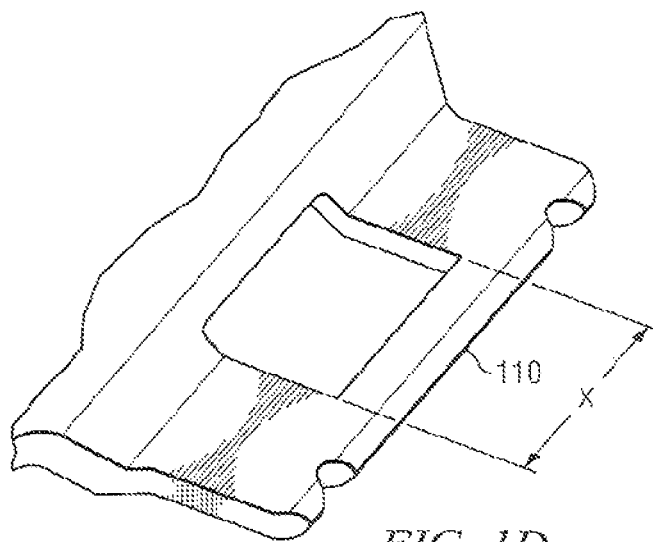


FIG. 1D

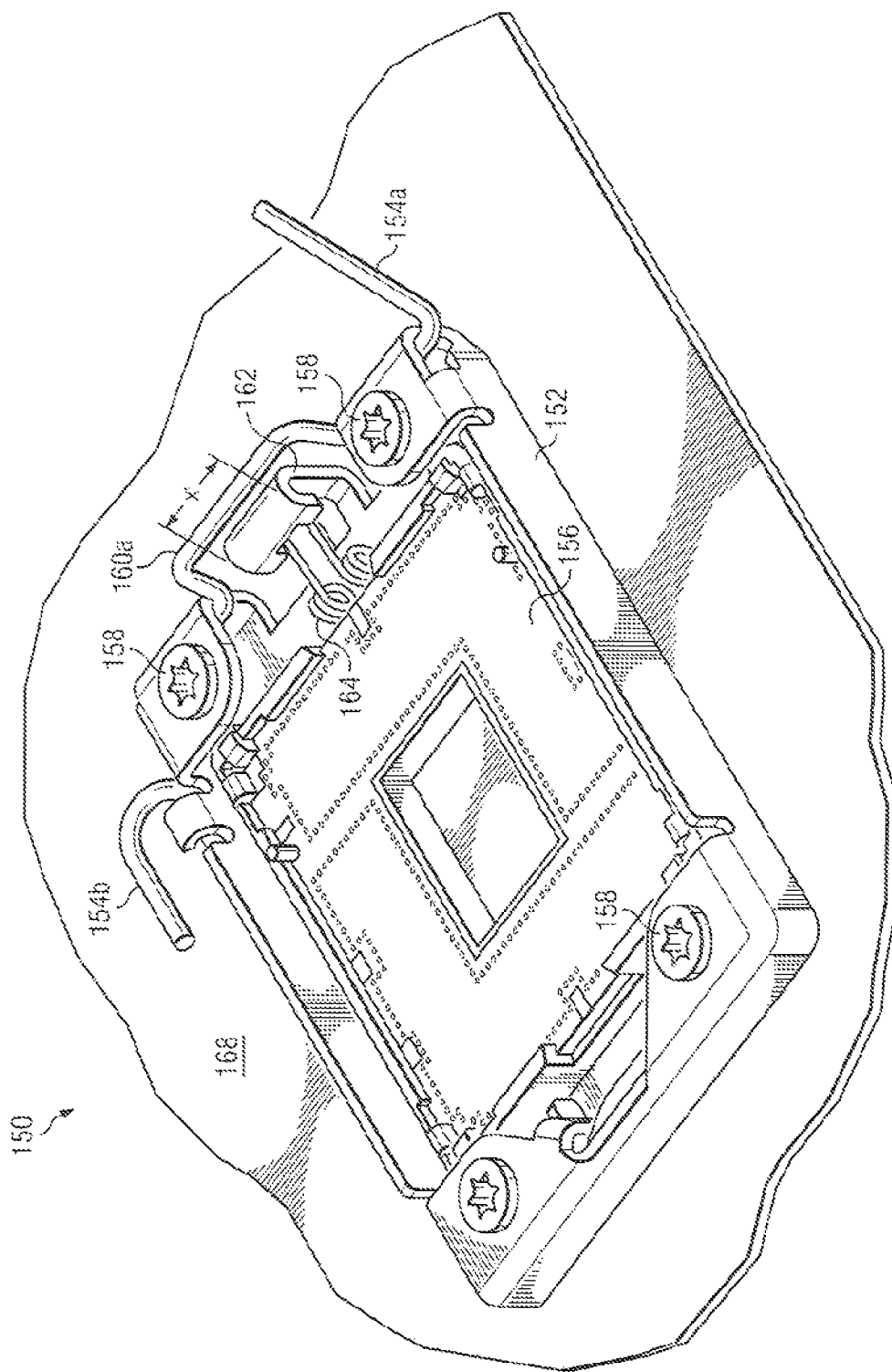


FIG. 1B

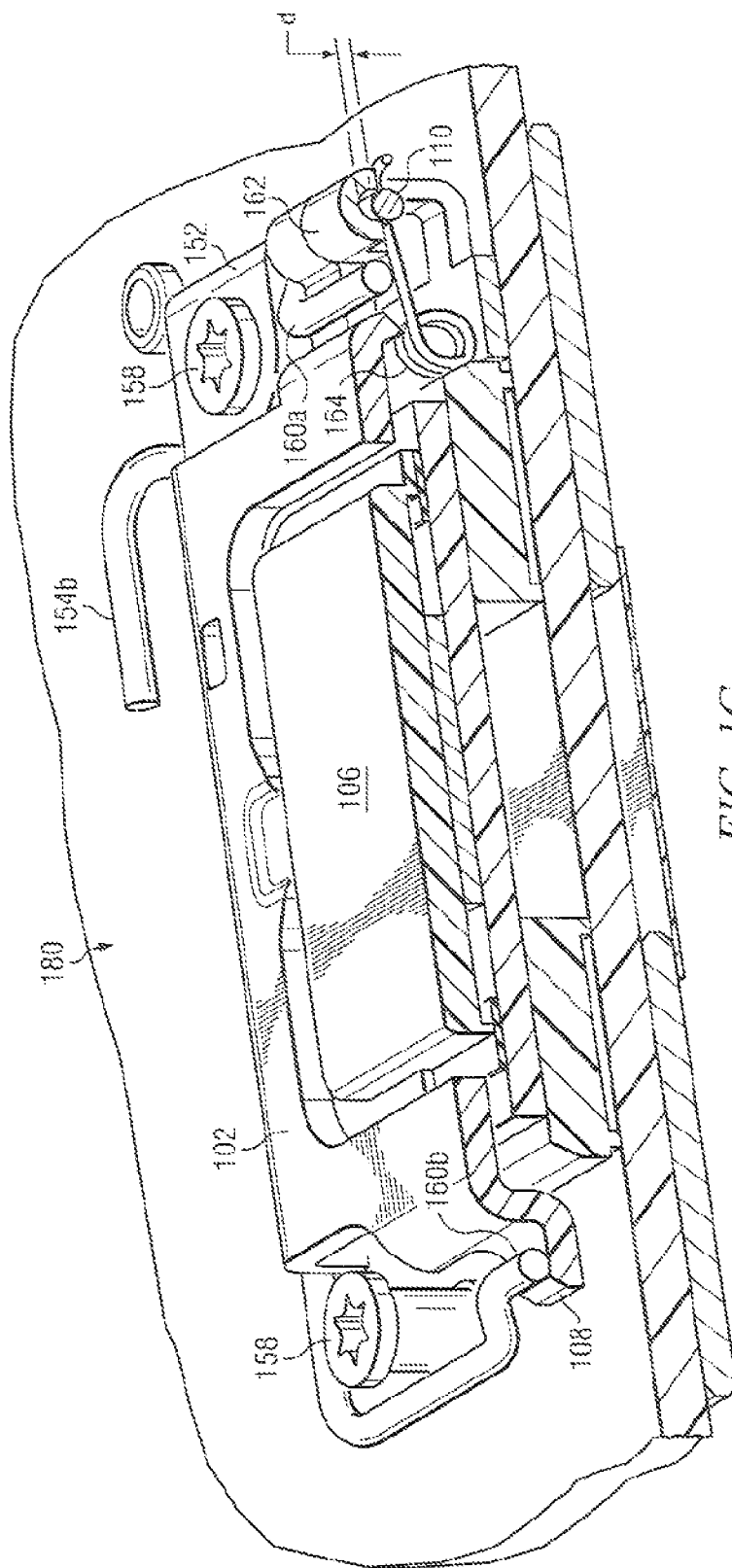


FIG. 1C

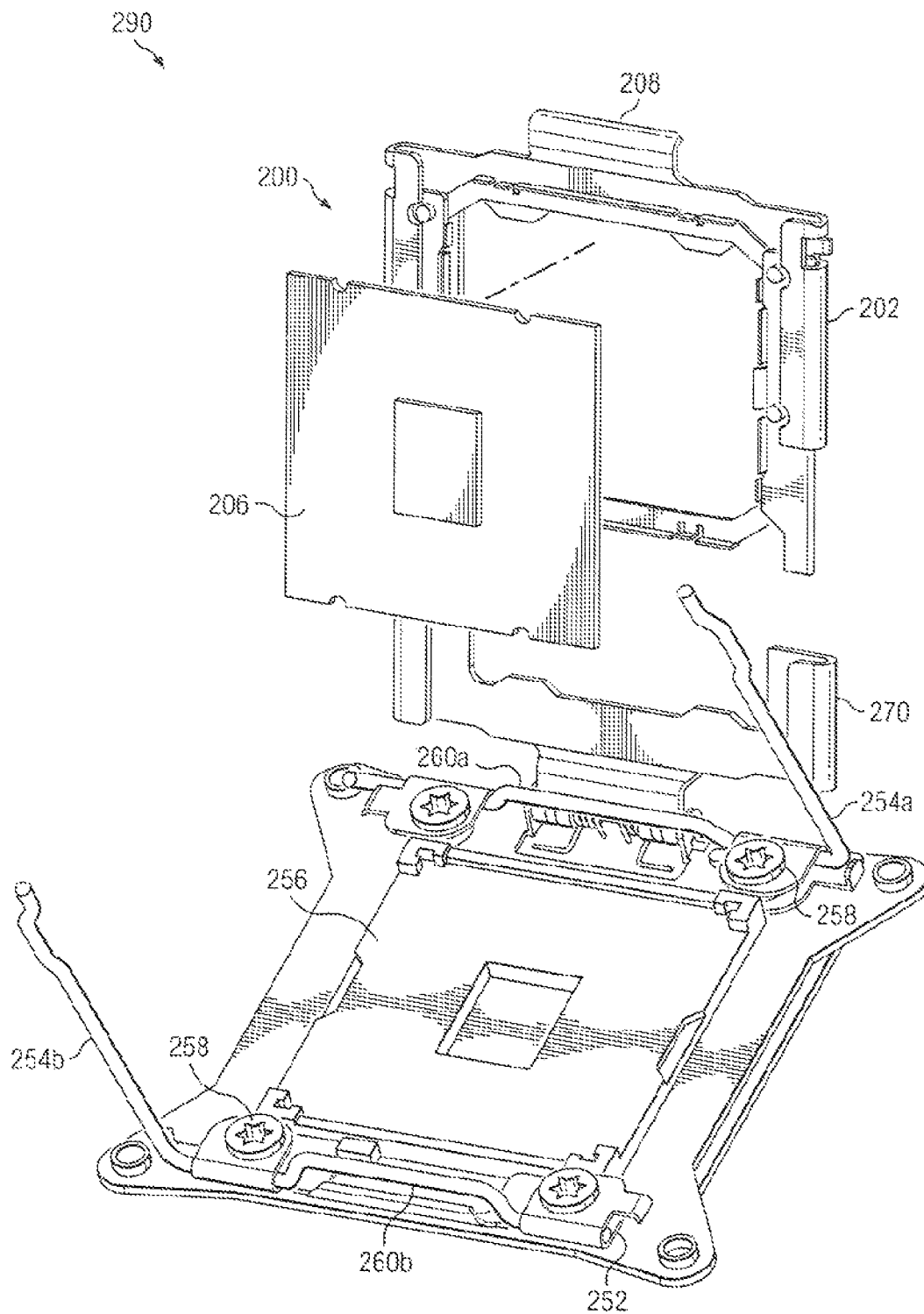


FIG. 2A

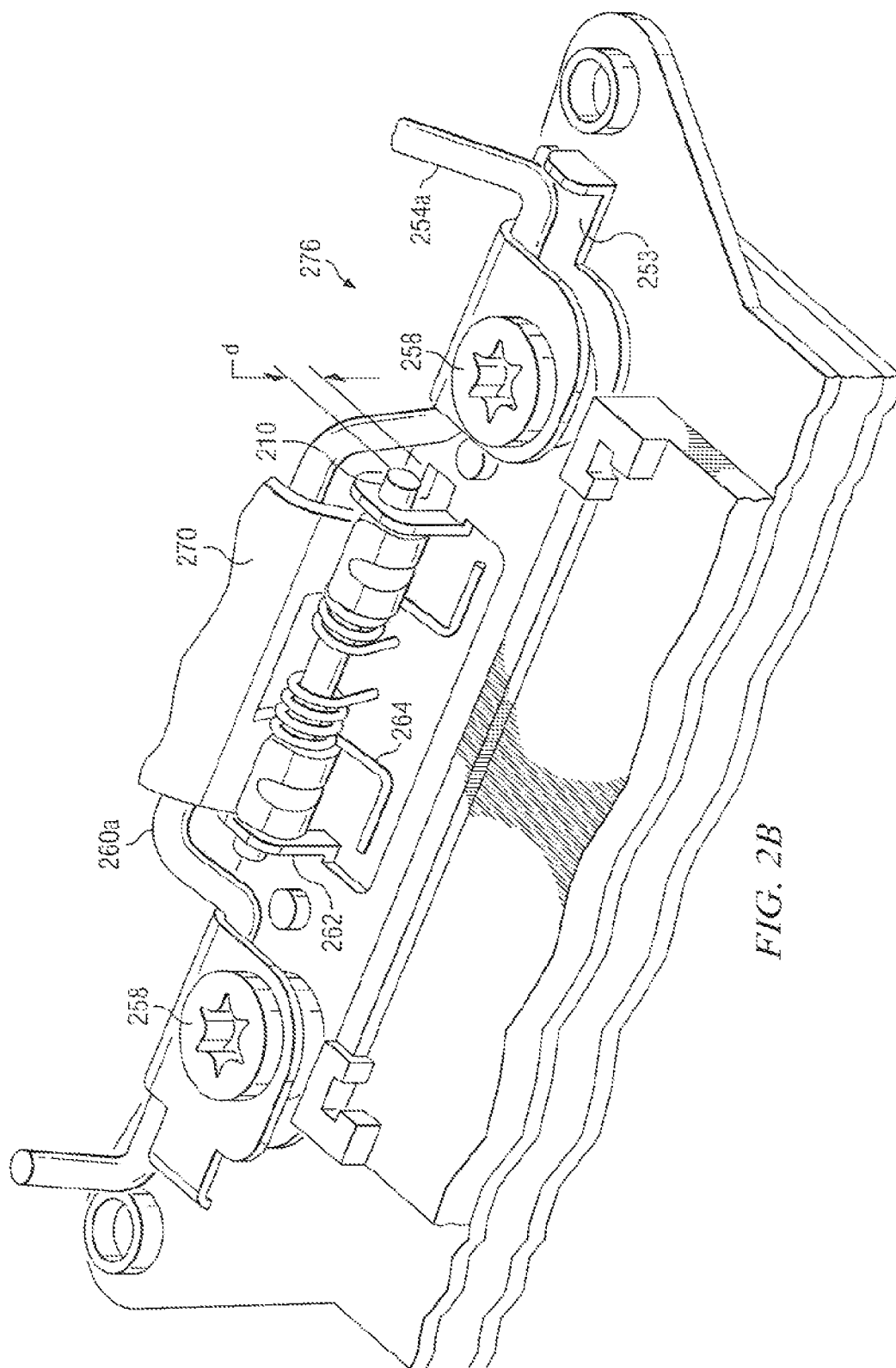
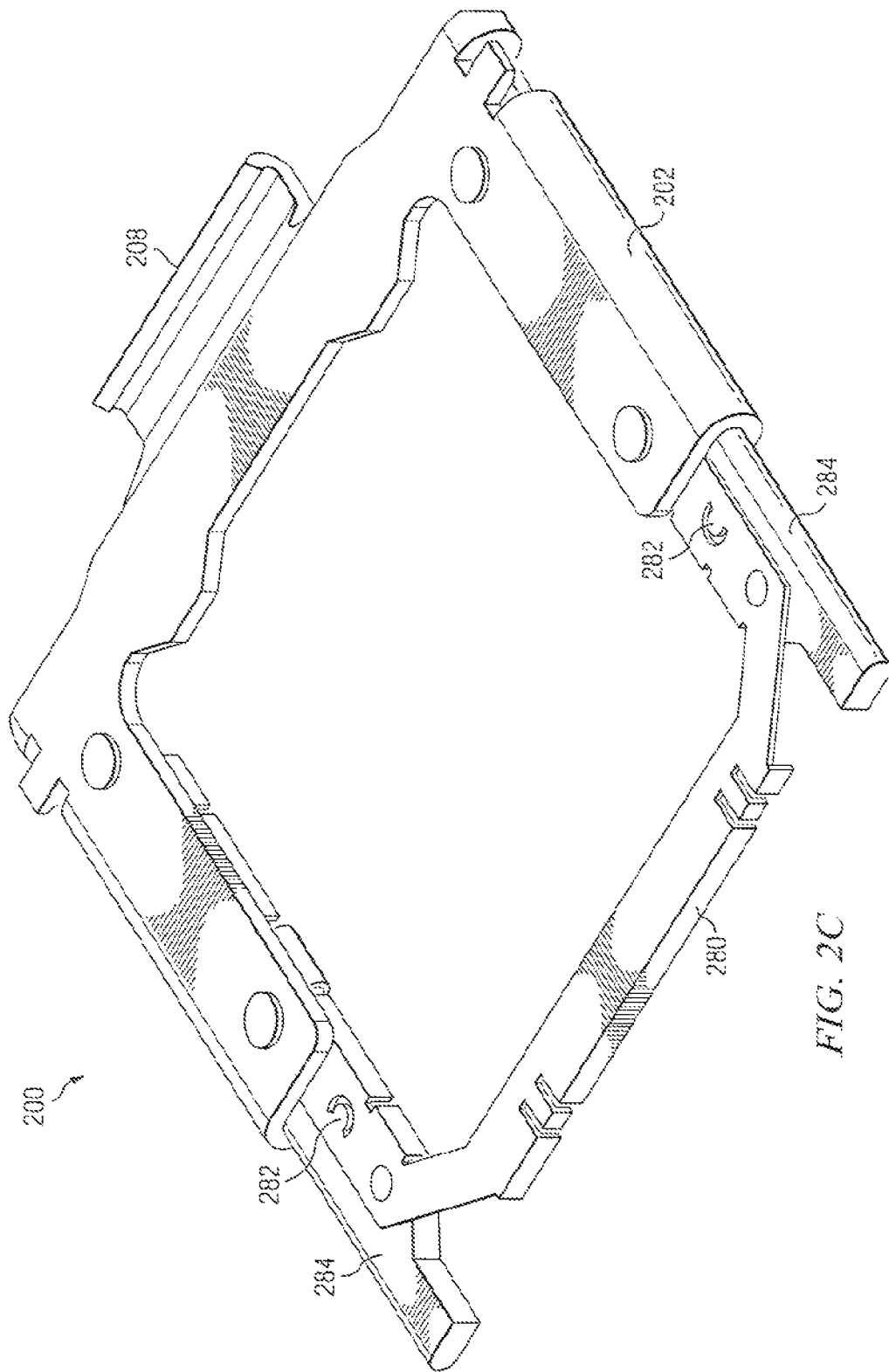
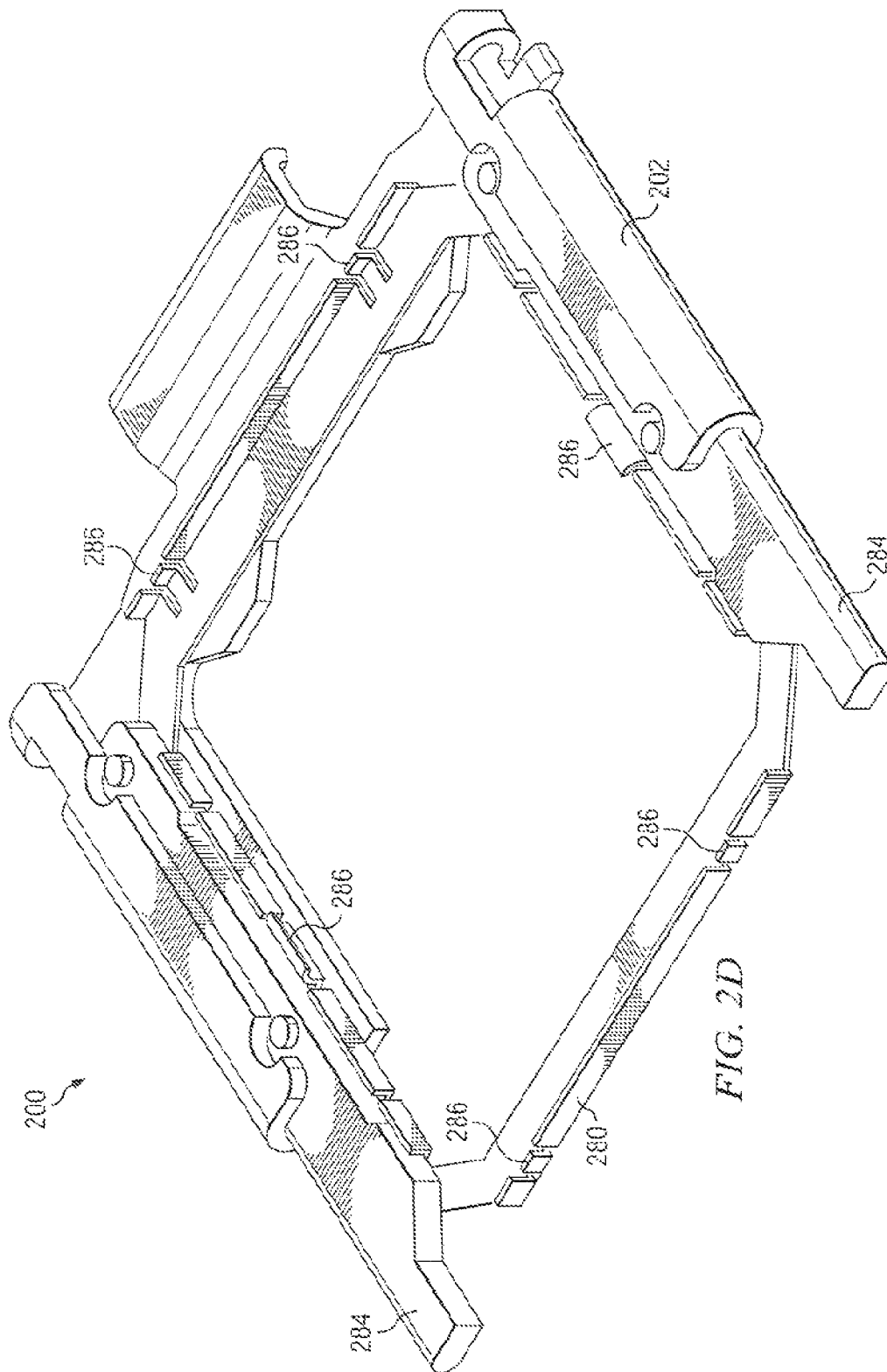


FIG. 2B







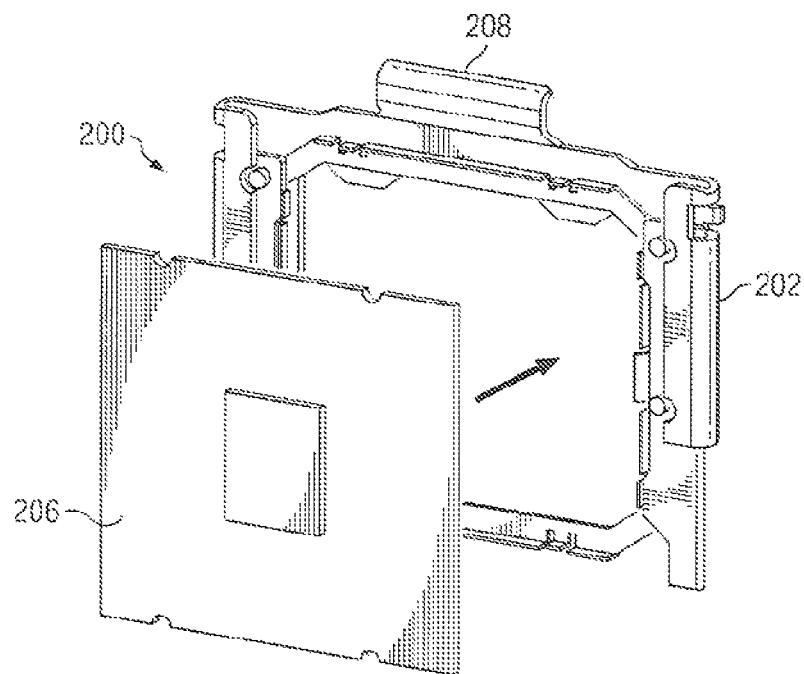


FIG. 3A

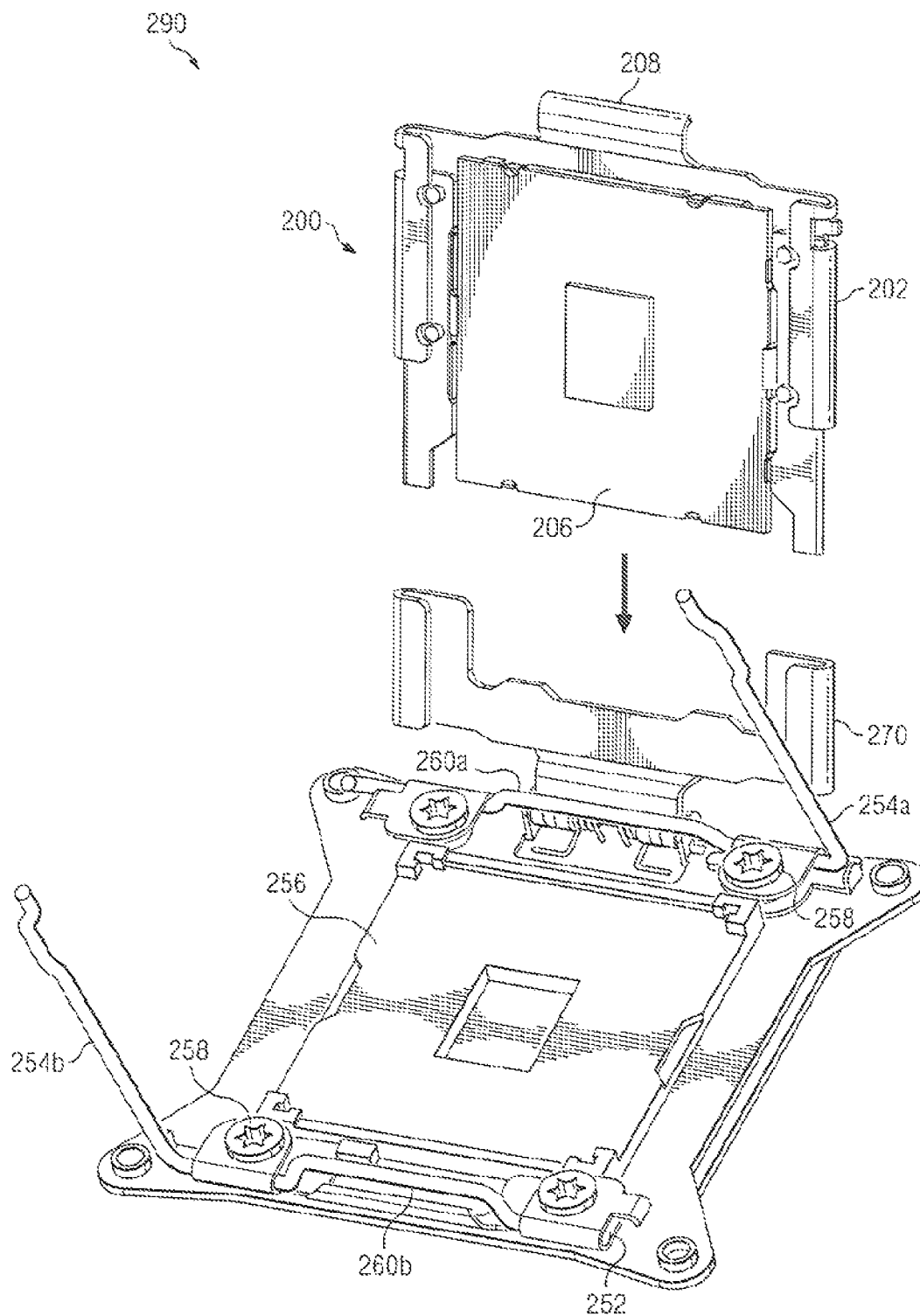


FIG. 3B

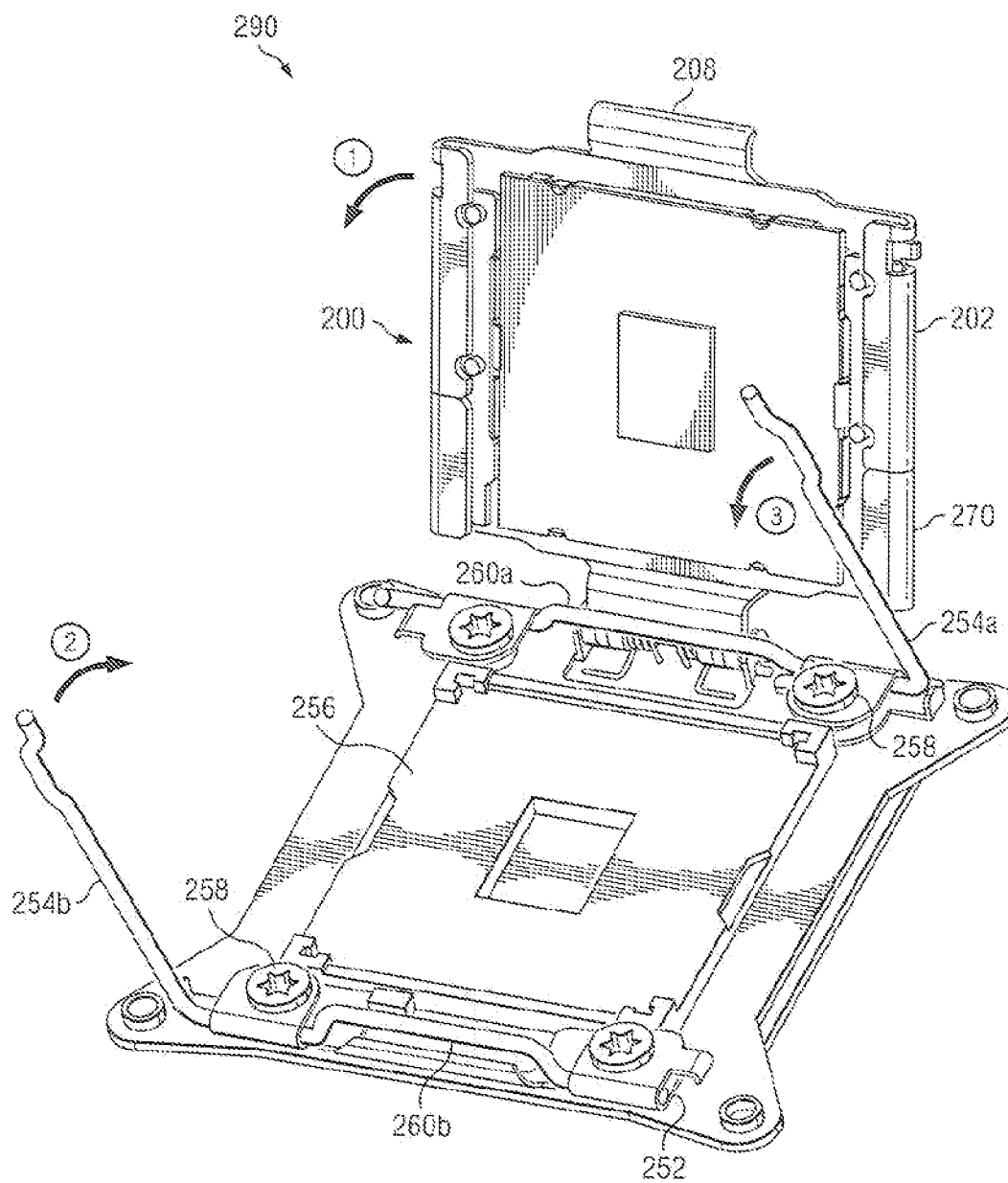
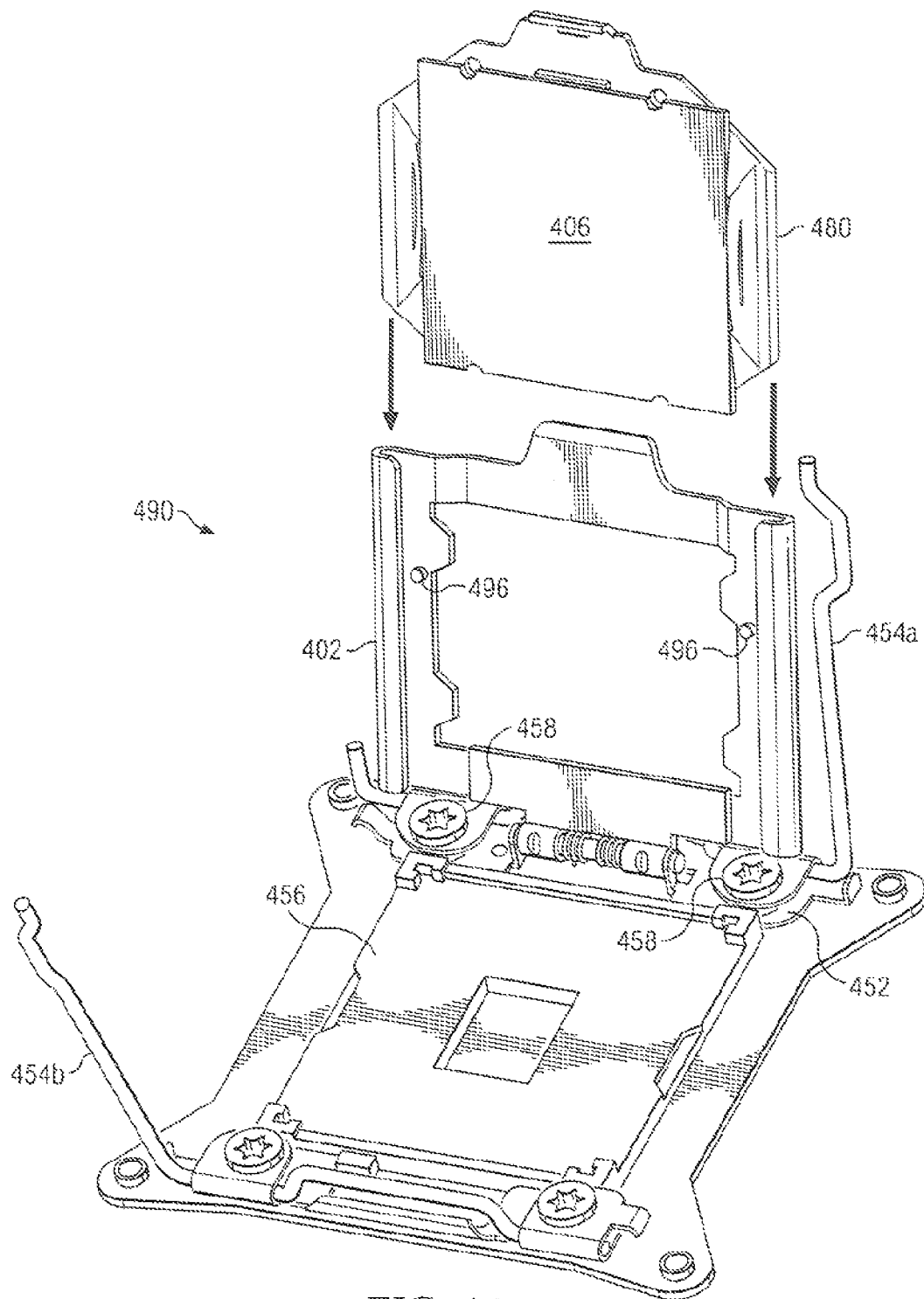


FIG. 3C



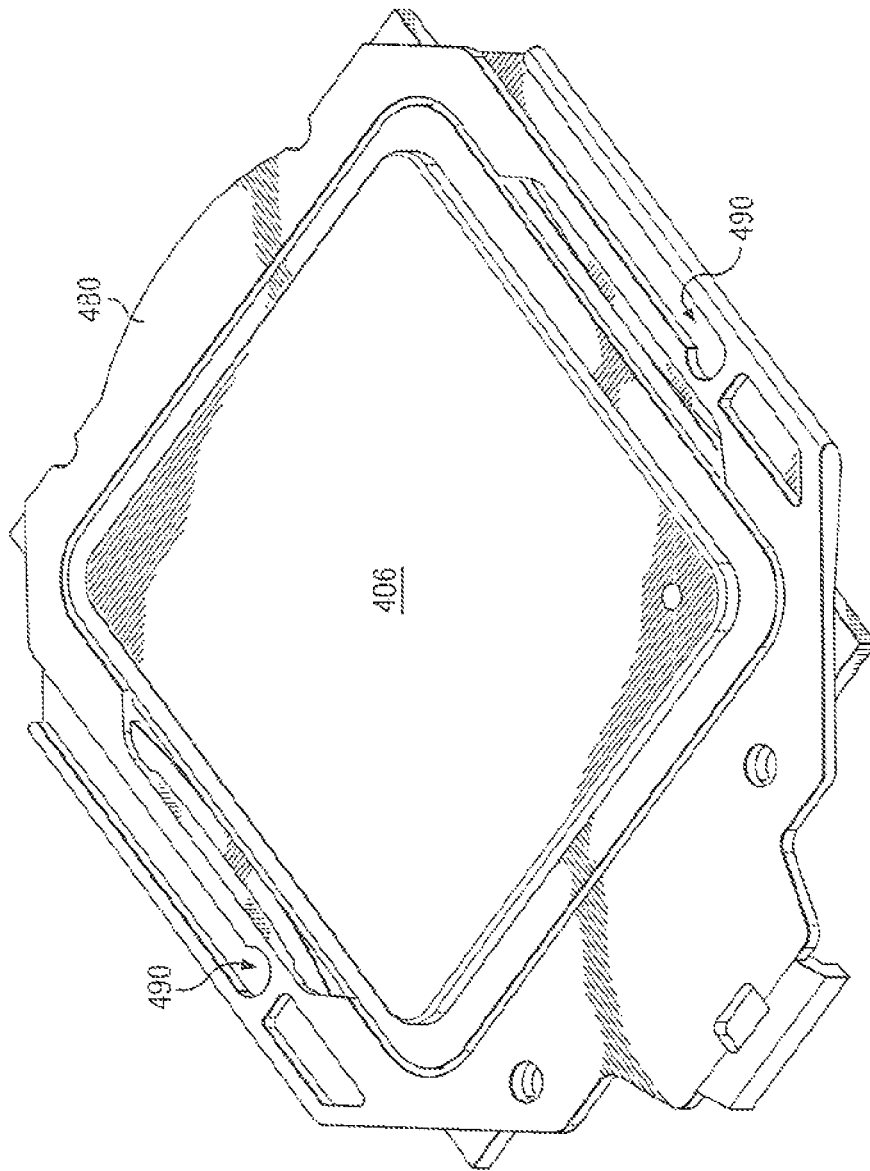
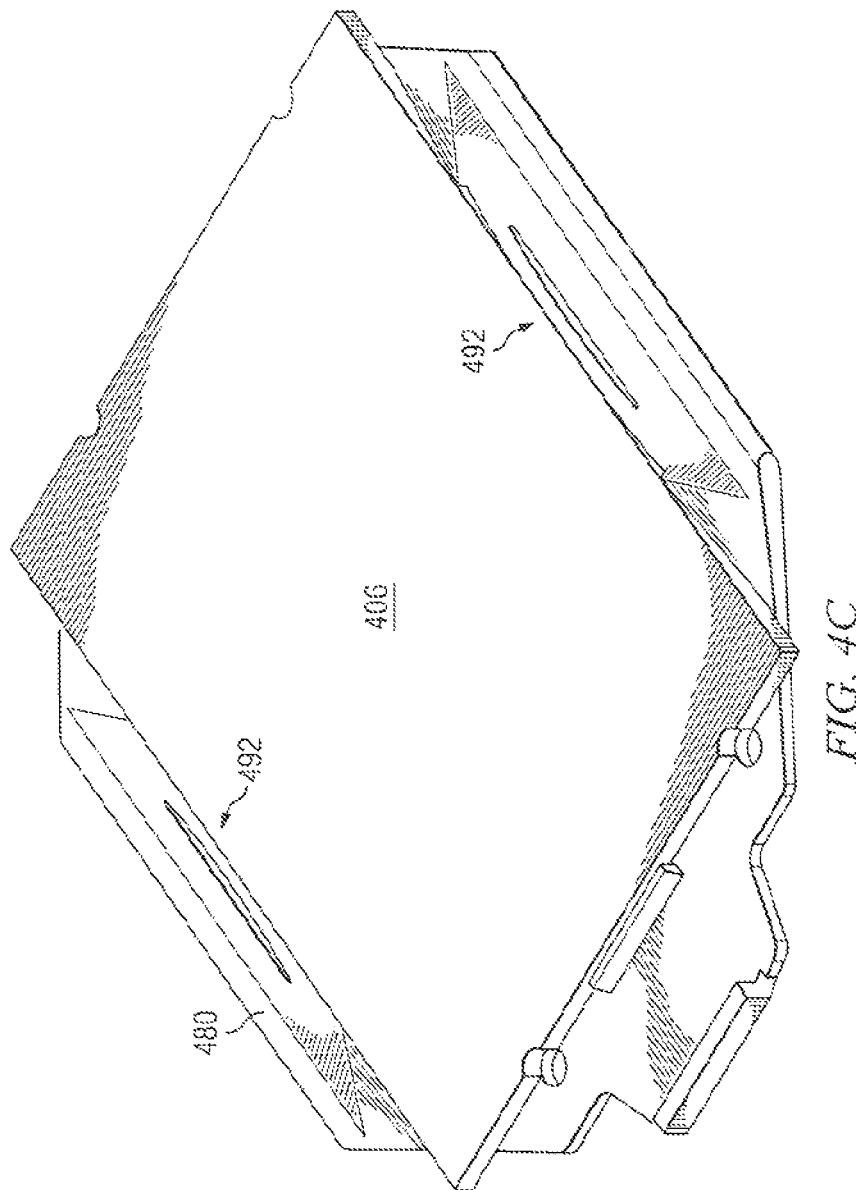


FIG. 4B





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## SPRING LOADED LID

## BACKGROUND

Many integrated circuits (IC) are mounted to a printed circuit (PC) board using a socket. One type of socket is a land grid arrays (LGA) socket. Older style sockets have holes in the socket that mate with pins attached to the underside of an IC. LGA sockets have protruding pins or spring contacts which touch contact pads on the underside of an IC. LGA sockets typically do not require any insertion force when installing the IC into the socket. The IC is held into the socket against the spring contacts by a lid. The lid is clamped in place once the IC has been loaded into the socket.

Aligning and inserting or removing the IC from the socket can be difficult. Many ICs have special tools designed to assist the insertion of the IC into the socket. Even using the special tool the spring contacts may be damaged when the IC is being inserted or removed from the socket. When the spring contacts in the socket become damaged, the socket must be replaced.

## BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1A is an isometric top view of a detachable lid assembly **100** in an example embodiment of the invention.

FIG. 1B is an isometric top view of a socket bottom **150** in an example embodiment of the invention.

FIG. 1C is an isometric top cutaway view of socket assembly **180** in an example embodiment of the invention.

FIG. 1D is an isometric top view of a section of a detachable lid assembly in an example embodiment of the invention.

FIG. 2A is an isometric top view of a socket assembly **290** in an example embodiment of the invention.

FIG. 2B is a close-up isometric view of the spring loading part of socket assembly **290**.

FIG. 2C is an isometric top view of detachable lid assembly **200** in an example embodiment of the invention.

FIG. 2D is an isometric bottom view of detachable lid assembly **200** in an example embodiment of the invention.

FIG. 3(A-C) is a pictorial representation for the assembly steps of a socket assembly in an example embodiment of the invention.

FIG. 4A is an isometric top view of a socket assembly **490** in an example embodiment of the invention.

FIG. 4B is an isometric top view of independent detachable IC holder **480**, in an example embodiment of the invention.

FIG. 4C is an isometric bottom view of independent detachable IC holder **480**, in an example embodiment of the invention.

## DETAILED DESCRIPTION

FIGS. 1-4 and the following description depict specific examples to teach those skilled in the art how to make and use the best mode of the invention. For the purpose of teaching inventive principles, some conventional aspects have been simplified or omitted. Those skilled in the art will appreciate variations from these examples that fall within the scope of the invention. Those skilled in the art will appreciate that the features described below can be combined in various ways to form multiple variations of the invention. As a result, the invention is not limited to the specific examples described below, but only by the claims and their equivalents.

In one example embodiment of the invention, an LGA socket will have a spring loaded lid. The spring loaded lid may have a bracket attached to the lid. The IC will be mounted into

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the lid/bracket. The spring will force the lid away from the contacts in the socket until a locking lever is moved into a closed position. Because the spring loaded lid is force away from the socket contacts, damage to the contacts in the socket may be reduced.

FIG. 1A is an isometric top view of a detachable lid assembly **100** in an example embodiment of the invention. Detachable lid assembly **100** comprises lid **102**, bracket **104** and integrated circuit (IC) **106**. Lid **102** is typically fabricated from a stiff material, for example metal. Bracket **104** is fabricated from a flexible material, for example Thermal Plastic Polyurethane (TPU). IC **106** may be any type of semiconductor device, for example a CPU, an application specific integrated circuit (ASIC), a memory device, or the like. Lid **102** has at least one tongue **108** that extends from one side of lid **102**. Lid **102** has hinge pin **110** attached to lid **102** on the opposite side from tongue **106**.

FIG. 1B is an isometric top view of a socket bottom **150** in an example embodiment of the invention. Socket bottom **150** comprises frame **152**, two locking levers (**154a** and **154b**), socket contacts **156** and spring **164**. Socket bottom **150** is attached to PC board **168** with screws **158**. In some example embodiments of the invention, a stiffener plate (not shown) maybe used on the bottom side of PC board **168** capturing PC board **168** between the stiffener plate and the frame **152**. The PC board **168** may be the mother board for a personal computer, the processor board of a blade, the memory board of a memory system, or the like.

A U-shaped tab **162** is formed at one end of frame **152**. The inside of U-shaped tab **162** forms a pivot channel that mates with hinge pin **110** on lid **102**. A pivot channel is a structure that allows the hinge pin to move vertically with respect to the frame, but restricts horizontal motion of the hinge pin. In addition the pivot channel allows the hinge pin to rotate inside the pivot channel about the long axis of the hinge pin. During assembly, the detachable lid assembly is positioned at an angle with respect to socket base **150** with the hinge pin closest to the socket base. The hinge pin **110** is then snapped into the U-shaped tab on the frame **152**. When detachable lid **102** is snapped into socket base **150**, hinge pin **110** fits into the pivot channel (inside the curved section of U-shaped tab **162**). Spring **164**, forces hinge pin **110** against the top of the pivot channel. The width X' of U-shaped tab **162** fits inside the gap X of hinge pin **110**. In one example embodiment of the invention, the position of hinge pin **110** with respect to the pivot channel is used to align IC **106** to the socket contacts **156**. In other embodiments, the IC may be aligned to the socket contacts **156** by one or more edges surrounding socket contacts **156**. Once the detachable lid **102** has been snapped into the frame, the lid **102** can be rotated, inside the pivot channel, onto the socket bottom **150**. In the open position detachable lid **102** will make an angle of between 45 and 115 degrees with respect to the socket contacts. The two locking levers can then be rotated from the open position into the closed position. As the locking levers are rotated into the closed position, locking bars **160a** and **160b** mate with the lid **102** and force the IC mounted in the lid **102** against the socket contacts **156**.

FIG. 1C is an isometric top cutaway view of socket assembly **180** in an example embodiment of the invention. Socket assembly **180** comprises detachable lid **102**, IC **106**, frame **152**, spring **164**, screws **158**, locking lever **154b** and locking bars **160a** and **160b**. FIG. 1C shows detachable lid **102** in the closed position with both locking levers in the closed position. Locking bar **150b** is shown forcing tongue **108** downward, and locking bar **160a** is shown forcing hinge pin **110** downward. Before locking lever **154a** (see FIG. 1b) is rotated

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into the closed position, locking bar **160a** does not force hinge pin **110** downwards. Therefore when locking lever **160a** is in the open position, spring **164** keeps hinge pin **110** pressed against the top of the pivot channel. When locking lever **154a** (see FIG. **1b**) is rotated into the closed position, locking bar **160a** forces hinge pin **110** downwards by distance **d**, forcing the underside of IC **106** against the socket contacts **156**. In one example embodiment of the invention distance **d** is between 0.5-3.5 mm. Distance **d** may be 2.4 mm.

Because spring **164** keeps hinge pin **110** up against the top of the pivot channel until locking lever is rotated into the closed position, the bottom surface of IC **106** may not make contact with socket contacts **156** until IC **106** is properly aligned with the socket contacts **156**. In one embodiment of the invention, the bottom surface of the IC may not touch the socket contacts when the hinge pin is at the top of the pivot channel and the lid is in the closed position. In other embodiment, the bottom surface of the IC may be resting on, or slightly compressing, the socket contacts when the hinge pin is at the top of the pivot channel and the lid is in the closed position. In one example embodiment of the invention, the force acting against hinge pin **110** by spring **164** is between 1 lbs and 3 lbs when the hinge pin is at the top of the pivot channel, and between 6 lbs and 10 lbs when the hinge pin is at the bottom of the pivot channel. The spring force may be 2 lbs when the hinge pin is at the top of the pivot channel, and 7 lbs when the hinge pin is at the bottom of the pivot channel. In some example embodiments the spring force is supplied by two springs. In one example embodiment, the lid **200** may not be detachable, but may be permanently attached to the socket frame.

In another example embodiment of the invention, hinge pin **110** may not be cylindrical in shape. FIG. **1D** is an isometric top view of a section of a detachable lid assembly in another example embodiment of the invention. Hinge pin **110** in FIG. **1D** is not a separated cylindrical part held by tabs of the lid **102**. Hinge pin **110** in FIG. **1D** is formed as part of the sheet metal of lid **102** and comprises a flat section of length **X**. When detachable lid **102** is snapped into socket base **150**, the flat hinge pin **110** fits into the pivot channel (inside the curved section of U-shaped tab **162**). Spring **164**, forces hinge pin **110** against the top of the pivot channel. The width **X'** of U-shaped tab **162** fits inside the gap **X** of hinge pin **110**. The flat hinge pin is able to move vertically with respect to the frame, but is restricted in horizontal motion. In addition the pivot channel allows the flat hinge pin to rotate inside the pivot channel about the long axis of the hinge pin.

In another example embodiment of the invention, the lid may be divided into two parts: a detachable part and a spring loaded part. FIG. **2A** is an isometric top view of a socket assembly **290** in an example embodiment of the invention. Socket assembly **290** comprises: frame **252**, screws **258**, socket contacts **256**, two locking levers **254a** and **254b**, detachable lid **200**, spring loaded lid **270** and IC **206**. FIG. **2a** shows detachable lid **200** detached from spring loaded lid **270** with IC **206** ready to be installed into detachable lid **200**. Spring loaded lid **270** is shown in the open position making an angle of approximately 95 degrees with respect to socket contacts **256**.

FIG. **3(A-C)** is a pictorial representation for the steps used to assemble a socket assembly in an example embodiment of the invention. At step one (FIG. **3a**) the IC is loaded into the detachable lid. At step 2 (FIG. **3b**) the detachable lid is inserted into the spring loaded lid while the spring loaded lid is in its open position. Spring loaded lid makes a large angle (45-115 degrees) with respect to socket contacts **256** when in the open position. At step 3 (FIG. **3c**) the two part lid (the

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detachable lid and the spring loaded lid) is rotated down onto the socket bottom (as shown by arrow **1**). At step 4 (FIG. **3c**) the lower locking lever is rotated into its closed position (shown by arrow **2**), thereby capturing tongue **208** and forcing one end of the IC mounted in the two part lid down against the socket contacts. At step 5 (FIG. **3c**) the upper locking level is rotated into its closed position (as shown by arrow **3**), compressing springs **264** and pushing hinge pin **210** down in the pivot channel, thereby forcing the other end of IC mounted in the two part lid down against the socket contacts.

The two locking levers are installed into frame **252** with one locking lever

mounted at each end of frame **252** (see FIG. **2a**). Each locking lever (**254a** and **254b**) has a locking bar **260a** and **260b**. Locking bar **260a** is shown in front of spring loaded lid **270** (for clarity). In actual operation, locking bar **260a** is located behind spring loaded lid **270** (as shown in FIG. **2b**). Both locking levers (**254a** and **254b**) can be rotated between an open position and a closed position. Both locking levers are shown in the open position in FIG. **2a**. When locking lever **254b** is rotated into its closed position, locking bar **260b** captures tongue **208**, forcing detachable lid downward. When locking lever **254a** is rotated into its closed position, locking bar **260a** forces spring loaded lid downward.

FIG. **2B** is a close-up isometric view of the spring loading part of socket assembly **290**. A hinge pin **210** is attached to one end of spring loaded lid **270**. Hinge pin **210** is captured inside slots formed in two parallel tabs **262** bent vertically from frame **253**. The two slots form a pivot channel. A pivot channel is a structure that allows the hinge pin to move vertically with respect to the frame, but restricts horizontal motion of the hinge pin. In addition the pivot channel allows the hinge pin to rotate inside the pivot channel about the cylindrical axis of the hinge pin. At least one spring **264** is attached to hinge pin **210** and pushes against the bottom of socket assembly **290**, forcing hinge pin **210** up into the top of the pivot channel. Hinge pin **210** can move distance **d** downwards inside the pivot channel by compressing spring **264**. Hinge pin **210** is free to rotate around its cylindrical axis inside pivot channel. Locking lever **254a** is shown in the open position with locking bar **260a** behind spring loaded lid.

FIG. **2C** is an isometric top view of detachable lid assembly **200** in an example embodiment of the invention. FIG. **2D** is an isometric bottom view of detachable lid assembly **200** in an example embodiment of the invention. Detachable lid assembly **200** comprises lid **202**, IC holder **280**, and 2 stiffeners **284**. Lid **202** is fabricated from a stiff material, for example metal. Lid **202** has tongue **208** formed at one end IC holder **280** is attached to lid **202**. Stiffeners **284** are attached to IC holder with IC holder in-between the lid and the stiffeners (see FIG. **2d**). IC holder is formed to retain an IC inserted into IC holder. In one embodiment, IC holder **280** may be fabricated from a flexible material and uses an interference, fit to retain the IC in another embodiment, the IC may snap into IC holder **280** and be retained by the snap features in IC holder **280**.

Detachable lid is configured to be inserted into the spring loaded lid **270**. Stiffeners **284** mate with channels formed in the spring loaded lid, allowing the detachable lid to be slid into the spring loaded lid. IC holder may have 2 "click" detents **282** formed in the top surface of IC holder **280**, one on each side. The "click" detents **282** snap into corresponding features in the spring loaded lid **270** to let a user know when the detachable lid has been fully inserted into the spring loaded lid **270**. By depressing the "click" features, detachable lid can be removed from the spring loaded lid.

In another example embodiment of the invention, the spring loaded lid may have an independent detachable IC

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holder that slides into the lid when the lid is in the open position. FIG. 4A is an isometric top view of a socket assembly 490 in an example embodiment of the invention. Socket assembly 490 comprises: frame 452, screws 458, socket contacts 456, two locking levers 454a and 454b, independent detachable IC holder 480, spring loaded lid 402 and IC 406. FIG. 4A shows independent detachable IC holder 480 detached from spring loaded lid 402 and ready to be installed into spring loaded lid 402 (as shown by arrows). IC is shown loaded into the independent detachable IC holder 480. Spring loaded lid 402 is shown in the open position making an angle (between 45 and 115 degrees) with respect to socket contacts 456. In one example embodiment, when independent detachable IC holder 480 is slid into spring loaded lid 402, the edges of independent detachable IC holder 480 fit into channels in spring loaded lid. Independent detachable IC holder 480 may have features that snap into place and lock independent detachable IC holder 480 into spring loaded lid 402 when independent detachable IC holder 480 is fully installed.

FIG. 4B is an isometric top view of independent detachable IC holder 480, in an example embodiment of the invention. FIG. 4C is an isometric bottom view of independent detachable IC holder 480, in an example embodiment of the invention. In FIG. 4B two slide in detents 490 can be seen formed into the two sides of the independent detachable IC holder 480. The two slide in detents interact with two pins 496 (one pin can be seen in FIG. 4A) formed in the two channels on spring loaded lid 402. The two slide in detents "snap" into place when the independent detachable IC holder 480 is fully inserted into spring loaded lid 402. Two friction stop features 492 are formed on the bottom side (see FIG. 4C) of independent detachable IC holder 480. The friction stop features interact with the two channels formed in spring loaded lid to hold the independent detachable IC holder 480 into the spring loaded lid.

In one example embodiment, IC 406 will be loaded into independent detachable IC holder before the IC is provided to a user. In another example embodiment, IC 406 will be loaded into independent detachable IC holder when IC is loaded into socket assembly 490. Independent detachable IC holder is formed to retain an IC inserted into the independent detachable IC holder. In one embodiment, independent detachable IC holder 280 may be fabricated from a flexible material and uses an interference fit to retain the IC. In another embodiment, the IC may snap into independent detachable IC holder 280 and be retained by snap features in IC holder 280. In another example embodiment of the invention, IC may be held in place using glue or epoxy.

In some example embodiment of the invention, the spring loaded lid will be friction loaded such that the lid will be held in place at any angle between the open position and the closed position. In one example embodiment of the invention, the friction loading will be supplied by the interaction of the hinge pin against the pivot channel and the spring. The spring and the pivot channel remain stationary as the hinge pin rotates when the lid is rotated between the open position and the closed position. The spring pushes against the hinge pin creating friction between the hinge pin and the spring. The hinge pin is also forced against the top side of the pivot channel creating friction between the hinge pin and the pivot channel. The tolerance between the hinge pin and the spring and pivot channel, as well as the spring force of the spring, can be adjusted to hold the lid in place at any position between the open and closed position.

In another example embodiment of the invention, the friction loading may be supplemented by the interaction of the tabs 262 and the ends of the hinge pin 210. Tabs 262 may be

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bent slightly inward such that the distance between the tabs is smaller at the top of the pivot channel than at the bottom of the pivot channel. As hinge pin moves towards the top of the pivot channel the tabs 262 will act like springs holding the edges of lid 270 between them. The tolerance between the edges of lid 270 and the angle of the tabs 262, can be adjusted to help hold the lid in place at any position between the open and closed position.

What is claimed is:

1. An apparatus, comprising:

a frame to be attached to a primary surface of a PC board; a first locking lever mounted in the frame and configured to be rotated between an open position and a closed, position wherein the first locking lever is mounted on one side of the frame;

a lid, the lid having a hinge pin on one side of the lid;

the frame having a pivot channel formed near the first locking lever wherein the hinge pin couples to the pivot channel and allows the lid to pivot between an open position and a closed position, the pivot channel having a length d between a top end and a bottom end of the pivot channel;

at least one spring, the at least one spring acting to force the hinge pin towards the top end of the pivot channel;

wherein the hinge pin is forced down towards the bottom end of the pivot channel when the lid is in the closed position and the first locking lever is moved from its open position into its closed position.

2. The apparatus of claim 1, wherein the hinge pin removably snaps into the pivot channel.

3. The apparatus of claim 1, wherein the lid further comprises:

a spring loaded section, the spring loaded section having the hinge pin attached on a first side;

a detachable section, the detachable section removably snapping into a second side of the spring loaded section, wherein the second side is opposite the hinge pin.

4. The apparatus of claim 1, wherein the lid further comprises:

a first side channel and a second side channel, the second side channel opposite the first side channel, wherein the two side channels are parallel;

an independent detachable IC holder, the independent detachable IC holder having two side edges, wherein the two side edges removably slidably fit into the first and second side channels in the lid.

5. The apparatus of claim 1, further comprising:

a second locking lever mounted in the frame and configured to be rotated between an open position and a closed position, the second locking lever is mounted on the opposite side of the frame from the first locking lever, and wherein the lid has a tongue formed on the opposite side from the hinge pin and the second locking lever captures the tongue and forces the lid downwards when the lid is in the closed position and the second locking lever is rotated from the open position to the closed position.

6. The apparatus of claim 1 wherein the lid further comprises:

a bracket attached to the lid, the bracket having snap features that retain an IC when inserted into the bracket.

7. The apparatus of claim 1 wherein the at least one spring supplies a spring force between the frame and the hinge pin of between 1 lb and 3 lbs when the hinge pin is at the top of the top end of pivot channel and between 5 lbs and 10 lbs when the hinge pin is at the bottom end of the pivot channel.

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8. The apparatus of claim 1 wherein the distance d is between 0.5 mm and 3.5 mm.

9. The apparatus of claim 1 wherein the pivot channel is formed by slots in two parallel tabs attached to the frame.

10. The apparatus of claim 1 wherein the hinge pin is cylindrical in shape.

11. The apparatus of claim 1 wherein the lid is friction loaded such that the lid will remain in position at any location between the open and closed positions.

12. An apparatus, comprising:

a PC board;

a frame attached to a primary surface of the PC board;

a first locking lever mounted in the frame and configured to be rotated between an open position and a closed position wherein the first locking lever is mounted on one side of the frame;

a lid, the lid having a hinge pin on one side of the lid;

the frame having a pivot channel formed near the first locking lever wherein the hinge pin couples to the pivot channel and allows the lid to pivot between an open position and a closed position, the pivot channel having a length d between a top end and a bottom end of the pivot channel;

at least one spring, the at least one spring acting against the frame and the hinge pin to force the hinge pin towards the top side of the pivot channel;

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wherein the hinge pin is forced down towards the bottom side of the pivot channel when the lid is in the closed position and the first locking lever is moved from its open position into its closed position;

an IC loaded in the lid.

13. The apparatus of claim 12, wherein the hinge pin removably snaps into the pivot channel.

14. The apparatus of claim 12, wherein the lid further comprises:

a first side channel and a second side channel, opposite the first side channel, wherein the two side channels are parallel;

an independent detachable IC holder, the independent detachable IC holder having two side edges wherein the two side edges removably slidably fit into the first and second side channels in the lid and wherein the IC is loaded into the independent detachable IC holder.

15. A method for mounting a semiconductor into a socket, comprising:

installing an IC into a lid;

rotating the lid into a closed position;

clamping the lid to a frame by rotating at least one locking lever from an open position to a closed position, wherein the lid is forced down towards socket contacts against a spring when the first locking lever is moved from its open position into its closed position.

\* \* \* \* \*

UNITED STATES PATENT AND TRADEMARK OFFICE  
**CERTIFICATE OF CORRECTION**

PATENT NO. : 9,192,070 B2  
APPLICATION NO. : 13/984168  
DATED : November 17, 2015  
INVENTOR(S) : Chong S. Tan

Page 1 of 1

It is certified that error appears in the above-identified patent and that said Letters Patent is hereby corrected as shown below:

IN THE CLAIMS

In column 6, line 14, in Claim 1, delete “closed,” and insert -- closed --, therefor.

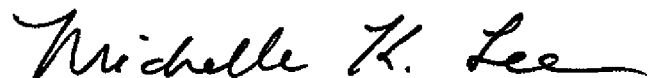
In column 6, line 16, in Claim 1, delete “frame:” and insert -- frame; --, therefor.

In column 6, line 45, in Claim 4, delete “edges,” and insert -- edges --, therefor.

In column 7, line 20, in Claim 12, delete “pm” and insert -- pin --, therefor.

In column 8, line 11 approx., in Claim 14, delete “he” and insert -- the --, therefor.

Signed and Sealed this  
Fifth Day of April, 2016



Michelle K. Lee  
*Director of the United States Patent and Trademark Office*